

USING A CHOICE ASSESSMENT TO PREDICT REINFORCER EFFECTIVENESS

CATHLEEN C. PIAZZA, WAYNE W. FISHER, LOUIS P. HAGOPIAN,
LYNN G. BOWMAN, AND LISA TOOLE

KENNEDY KRIEGER INSTITUTE AND
THE JOHNS HOPKINS UNIVERSITY SCHOOL OF MEDICINE

A choice assessment has been found to be a more accurate method of identifying preferences than is single-item presentation. However, it is not clear whether the effectiveness of reinforcement varies positively with the degree of preference (i.e., whether the relative preference based on the results of a choice assessment predicts relative reinforcer effectiveness). In the current study, we attempted to address this question by categorizing stimuli as high, middle, and low preference based on the results of a choice assessment, and then comparing the reinforcing effectiveness of these stimuli using a concurrent operants paradigm. High-preference stimuli consistently functioned as reinforcers for all 4 clients. Middle-preference stimuli functioned as reinforcers for 2 clients, but only when compared with low-preference stimuli. Low-preference stimuli did not function as reinforcers when compared to high- and middle-preference stimuli. These results suggest that a choice assessment can be used to predict the relative reinforcing value of various stimuli, which, in turn, may help to improve programs for clients with severe to profound disabilities.

DESCRIPTORS: assessment, concurrent operants, predictive validity, reinforcer preference, developmental disabilities

Most systematic assessments of reinforcers for persons with severe to profound disabilities have focused on either identifying preferred stimuli without testing whether the stimuli were functional reinforcers (e.g., Cautela & Kastenbaum, 1967; Homme, Csanyi, Gonzales, & Rechs, 1969) or assessing the reinforcing effects of stimuli without first using a specific procedure for predicting which stimuli would function as reinforcers (e.g., Dattilo, 1986; Wacker, Berg, Wiggins, Muldoon, & Cavanaugh, 1985). Because the reinforcing effects of specific stimuli tend to vary across clients and contexts (e.g., Fehr, Wacker, Trezise, Lennon, & Meyerson, 1979; Rincover, Newsom, Lovaas, & Koegel,

1977), it is possible that a large number of stimuli would need to be evaluated in order to identify functional reinforcers for a given individual. Thus, Pace, Ivancic, Edwards, Iwata, and Page (1985) made an important advance in this area by integrating a simple procedure for identifying preferred stimuli based on direct observation of approach responses (i.e., preference assessment) with a method for quickly assessing whether preferred stimuli actually functioned as reinforcers (i.e., reinforcer assessment).

There are important methodological and conceptual distinctions between preference and reinforcer assessments. During preference assessments, a relatively large number of stimuli are evaluated to identify preferred stimuli. The reinforcing effects of a small subset of stimuli (i.e., the highly preferred stimuli) are then evaluated during the reinforcer assessment. Although the preference assessment is an efficient procedure for identifying potential reinforcers from a large

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Requests for reprints should be addressed to Cathleen C. Piazza, Neurobehavioral Unit, Kennedy Krieger Institute, 707 N. Broadway, Baltimore, Maryland 21205.

number of stimuli, it does not evaluate the reinforcing effects of the stimuli.

Fisher *et al.* (1992) extended the findings of Pace *et al.* (1985) by comparing the results of a single-stimulus and a choice presentation format. In the choice procedure, pairs of stimuli were presented simultaneously, and the client was asked to choose one stimulus over the other. Fisher *et al.* demonstrated that this choice procedure resulted in greater differentiation among stimuli and more reliably identified reinforcers when compared to the single-stimulus presentation developed by Pace *et al.*

Although Fisher *et al.* (1992) demonstrated that a choice assessment is a more sensitive measure of preference, it is not clear whether the effectiveness of reinforcement varies positively with the degree of preference (i.e., whether the relative preference for stimuli demonstrated during the choice assessment predicts relative reinforcer effectiveness). From an applied standpoint, it is important for clinicians to have a variety of potential reinforcers available and to be able to predict the relative effectiveness of those stimuli as reinforcers. Thus, in the current investigation, we evaluated whether a choice assessment could be used to predict relative effectiveness of stimuli identified as high, middle, and low preference.

METHOD

Subjects

Participants were 4 males admitted to a specialized inpatient unit for the assessment and treatment of severe destructive behavior. Julius was a 7-year-old male with deafness, chronic lung disease, and severe to profound mental retardation. He primarily used natural gestures (e.g., grabbing someone's hand to get attention) and vocalizations such as screaming to communicate. He occasionally responded to one-step commands when accompanied by cues (e.g., pointing to a chair

while saying "sit down"). Matt was a 19-year-old male with Down syndrome and severe to profound mental retardation. He could understand some simple two-step commands that occurred frequently in his daily routine and common object names and actions. Rusty was a 10-year-old male with autism and profound mental retardation who used three signs (*eat, more, go*). He knew the names of his family members, his name, and words that were used frequently in his daily routine. Sam was a 10-year-old male with autism and severe mental retardation. He used gestures to communicate his wants (e.g., pointing to objects). He could recognize the names of some familiar objects and follow one-step commands in the context of the activity.

Procedure

Caregiver interview. Caregivers (the person identified as assuming the care and supervision of the client throughout the day prior to the client's hospitalization) were asked to generate a list of potential reinforcers during a structured interview called the Reinforcer Assessment for Individuals with Severe Disabilities (RAISD) developed and described by Fisher, Piazza, Bowman, and Amari (*in press*). Fisher and colleagues have demonstrated that stimuli generated from the RAISD, when used in combination with a choice assessment, are more effective reinforcers than are stimuli from a standard list (e.g., such as used by Fisher *et al.*, 1992; C. Green *et al.*, 1988; Pace *et al.*, 1985; a copy of the RAISD is available from the authors upon request). The RAISD provides prompts to caregivers regarding preferred stimuli within the following general domains: visual, auditory, olfactory, edible, tactile, and social. The goal of the RAISD is to facilitate the identification of as many potential reinforcers as possible. Caregivers were asked not only to identify specific preferred stimuli but also to describe the con-

ditions under which those stimuli were preferred (e.g., eating Oreo® cookies dipped in milk). Following the interview, caregivers were asked to rank the stimuli generated from the assessment according to their predictions regarding child preference. For each client, the highest ranked stimuli (12 for Julius, 13 for Matt, and 16 for Rusty and Sam) were used in the choice assessment described below.

Choice assessment. The choice assessment was conducted in a manner identical to that described by Fisher et al. (1992). During the choice assessment, each stimulus was paired once with every other stimulus (66 for Julius, 78 for Matt, and 120 pair presentations or trials for Rusty and Sam). During each trial, two stimuli were placed 0.7 m apart and approximately 0.7 m in front of the client. Stimuli were presented either by placing the stimulus in front of the client or, for social stimuli, by having the therapist act out the activity (e.g., therapist claps). Client approach responses to one of the stimuli resulted in 5 s of access to that stimulus and removal of the other stimulus. Simultaneous approach to both stimuli (e.g., reaching for both stimuli) was blocked by the therapist. If no approach response was made within 5 s, the therapist prompted the client to sample both stimuli by giving the stimulus to the client or by engaging in the activity with the client (e.g., therapist throws a ball to the client). The two stimuli were then re-presented for an additional 5 s, and approach responses resulted in 5 s of access to the chosen stimulus. If no response was made within 5 s, the stimuli were removed, and the next trial began.

Reinforcer assessment. The reinforcer assessment consisted of a comparison of the reinforcing effectiveness of stimuli defined as high, middle, and low preference based on the results of the choice assessment. Stimuli were divided into categories of high, middle, and low, based on how frequently the pa-

tient selected the stimulus during the choice assessment. *High-preference* stimuli were defined as the three items or activities approached most frequently by the client during the choice assessment (i.e., stimuli ranked 1st, 2nd, and 3rd). *Middle-preference* stimuli were defined as the three items or activities chosen closest to the median number of times (e.g., the 7th, 8th, and 9th ranked stimuli). *Low-preference* stimuli were defined as the three items or activities chosen the least (e.g., the 13th, 14th, and 15th). The stimulus selected least frequently (e.g., 16) was not used in the assessment so that the category rankings (i.e., high, middle, low) were equidistant from each other. In cases in which the caregiver was unable to identify at least 15 preferred stimuli (Julius and Matt), the best possible approximation of these three sets of stimuli was selected. The stimuli identified as high, middle, and low from the choice assessment were then compared during the reinforcer assessment.

Prior to each phase of the reinforcer assessment, training trials were conducted to teach the client to gain access to the stimuli being assessed in that phase (a description of the phases and the stimuli assessed is presented below). A training trial consisted of placing the stimulus being evaluated in a square or in a chair, and then allowing the child 5 s to independently engage in the target behavior (i.e., stand in a square or sit in a chair). If the child failed to engage in the target behavior, sequential verbal, gestural, and physical prompts were used to assist the child to emit the behavior. When the child stood in the square or sat in the chair, access to the stimulus was provided immediately. The trial ended when the child left the square or chair or 10 s had elapsed, whichever came first. Training was conducted in blocks of 10 trials. Training trials ended when the child independently engaged in the target behavior (i.e., in-square or in-

chair) for 80% of three consecutive blocks of 10 trials.

During reinforcer assessment, a concurrent operants paradigm (Catania, 1963; Herrnstein, 1970) was used to evaluate the reinforcing effects of the high-, middle-, and low-preference stimuli. Three responses were concurrently available during each session (i.e., having one's body positioned in Square A, B, or C for Julius and Matt or sitting in Chair A, B, or C for Rusty and Sam). One of the three squares or chairs served as a control (i.e., no reinforcement was provided), and standing or sitting in the other two squares or chairs produced access to a stimulus (e.g., sitting in Chair A resulted in access to a high-preference stimulus, sitting in Chair B produced access to a low-preference stimulus, and sitting in Chair C was on extinction). In one phase, high stimuli were compared with middle stimuli; in a second phase, high stimuli were compared with low stimuli; and in a third phase, middle stimuli were compared with low stimuli. The order of the comparisons was selected at random (see Figure 1 for the order of phases for each client).

Prior to each session, the child was allowed to select the two stimuli to be compared in that session using an abbreviated or "mini" choice assessment. During the mini choice assessment, each stimulus in the category was paired once with every other stimulus for a total of three pair presentations per category. The stimulus selected most frequently was the stimulus used in the session. If each stimulus was chosen equally often, one stimulus was randomly selected for the session.

The two stimuli used in the session (selected based on the mini choice assessments) were randomly assigned to two of the squares or chairs, and the remaining square or chair served as a control. The stimuli were then placed in the squares or next to the chairs. In the case of social stimuli, a ther-

apist stood in the assigned square or sat in the assigned chair and modeled the social activity at the beginning of the session (e.g., clapping). A child gained access to a particular stimulus by standing in the square or sitting in the chair associated with that stimulus. If the child left the square or got up from the chair, the stimulus was withdrawn or terminated. Sessions lasted 10 min.

Data Collection and Reliability

All sessions were conducted in individual treatment rooms (approximately 3 m by 3 m) equipped with one-way mirrors. Trained observers recorded client responses while seated either behind the mirror or in the room with the client. During the choice assessments, trained observers recorded each time the client approached the presented stimuli during each trial. Approach responses were defined as the client moving toward the stimulus with any part of the body within 5 s of stimulus presentation (Pace *et al.*, 1985). On an average of 95.45% of trials across clients, a second independent observer also recorded approach responses. The average agreement coefficients for approach responses across clients were (a) occurrence, 95.9% (range, 91.2% to 100%); (b) nonoccurrence, 100%; and (c) total, 94.6% (range, 88.4% to 100%). The reliability coefficients for each participant's choice assessment were calculated by dividing the number of agreements by the sum of agreements plus disagreements and multiplying by 100%. An agreement was defined as both observers recording that the same stimulus was approached (i.e., occurrence agreement) or that neither stimulus was approached (i.e., nonoccurrence agreement). A disagreement was defined as either (a) the two observers recorded that different stimuli were approached (used only for occurrence reliability), or (b) one observer recorded that one of the stimuli was approached and the other observer recorded

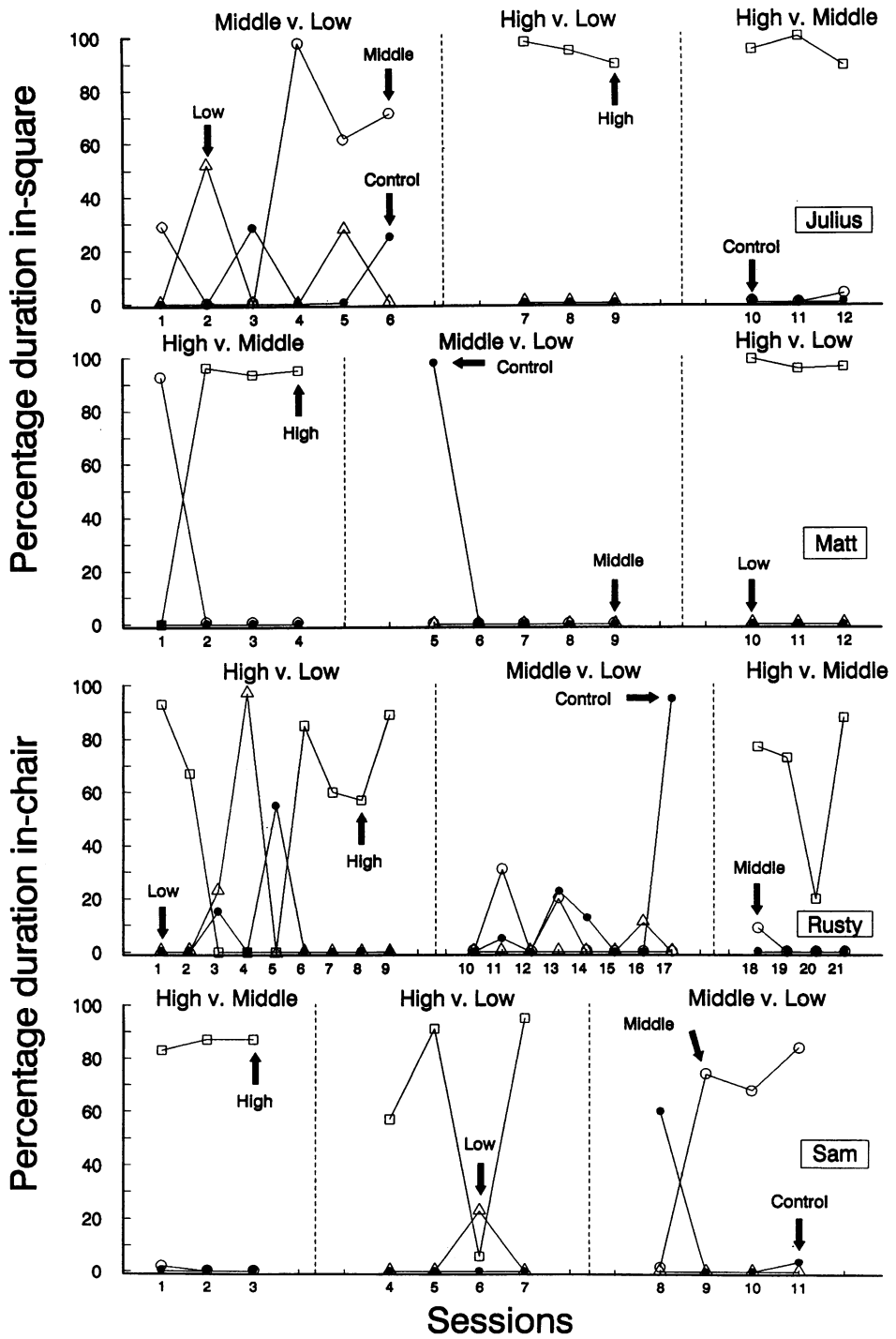


Figure 1. Percentage duration of in-square and in-chair behavior when associated with high, middle, low, or no (control) stimuli for the 4 clients.

that no approach response was made (used for both occurrence and nonoccurrence agreement).

During reinforcer assessment, the target responses were identical to those used by Fisher *et al.* (1992). That is, in-square behavior was used for individuals who resisted sitting in chairs (*i.e.*, Julius and Matt). The squares were 0.7 m by 0.7 m and were drawn on the floor with tape. *In-square* behavior was defined as the client having any portion of his body in the square. In-chair behavior was used for clients who sat for high-preference tasks but not for low-preference tasks (*i.e.*, Rusty and Sam). The three identical chairs were positioned approximately 1 m apart in a triangular formation. *In-chair* behavior was defined as contact of buttocks to the chair. Trained observers recorded total duration of in-square or in-chair behavior on laptop computers. A second independent observer recorded duration of in-square or in-chair behavior on an average of 72% of sessions across clients. Exact interval-by-interval agreement coefficients were calculated for duration of in-square or in-chair behavior using the formula described above. An agreement was defined as a 10-s interval during which both observers recorded the same duration (in seconds) of the target behavior. In Phase 2, the average exact agreement coefficient across clients was 97% (range, 93% to 99%).

RESULTS

The results from the reinforcer assessments are depicted in Figure 1. The stimuli identified as high preference based on the results of the choice assessment consistently functioned to reinforce in-chair or in-square behavior for all 4 clients and were superior to either the middle or low stimuli in terms of reinforcer effectiveness. For Julius, access to the high-preference stimuli resulted in an immediate and sustained increase in his in-

square behavior when compared to either the middle or the low stimuli. For Matt, initial response to the high stimuli was 0 when compared to the middle stimuli, but, after the first session, in-square behavior increased and remained near 100% for the high stimuli. When high and low stimuli were compared for Matt, access to high stimuli resulted in an average of 97% in-square behavior. For Rusty during the first phase (high *vs.* low), access to high-preference stimuli initially resulted in variable levels of in-chair behavior, but durations of in-chair behavior increased and stabilized over the course of the phase. When high and middle stimuli were compared, in-chair behavior averaged 64.5% for the high stimuli and 2.3% for the middle stimuli. For Sam, access to the high stimuli resulted in stable and high in-chair behavior when compared to the middle stimuli and more variable but high durations of in-chair behavior when compared to the low stimuli. For Julius and Sam, the middle stimuli also functioned as reinforcers and were superior to the low stimuli in terms of reinforcer effectiveness. However, for the other 2 clients, neither the middle nor the low stimuli functioned as reinforcers.

DISCUSSION

In the current investigation, we attempted to determine the extent to which preference, based on the results of a choice assessment, predicted relative reinforcer effectiveness. Stimuli categorized as high preference by the choice assessment consistently functioned as reinforcers across all clients and all relevant phases. Stimuli identified as moderately preferred (*i.e.*, middle stimuli) by the choice assessment functioned as reinforcers for 2 of the 4 clients when compared with low-preference stimuli. Stimuli identified as low preference by the choice assessment did not function as reinforcers for any clients when compared to high- or middle-preference

stimuli. Thus, the choice assessment appeared to predict relative reinforcer efficacy for the three categories of stimuli (high, middle, and low) with a reasonable degree of accuracy.

Relative reinforcer effectiveness was examined using simple free-operant behaviors. These arbitrary responses were selected for several reasons. First, because the study was designed to assess relative reinforcer effectiveness, the focus was on teaching the contingencies in effect (Response A produces Reinforcer A, Response B produces Reinforcer B) rather than on acquisition of a specific response or skill. Thus, we wanted to make the contingencies and the responses as simple and as clear as possible. Second, because inpatient admission lengths are limited, it was necessary to develop time-efficient methods that could be used across clients with varying degrees of mental retardation. We have found that most of our clients learn the contingencies associated with simple responses like in-square and in-seat behavior quickly, whereas more complex tasks often require extensive training. Third, when clients fail to learn more complex tasks, it is sometimes difficult to differentiate between skill deficits and reinforcer ineffectiveness.

When assessing relative reinforcer effectiveness using a concurrent operants paradigm, the response chosen as the dependent variable may be less important than when assessing reinforcer effectiveness in a single-operant situation. With a concurrent operants paradigm, two schedules of reinforcement (or two qualitatively different reinforcers) are in direct competition, and response rates tend to match the relative rate or magnitude of reinforcement associated with each schedule (Herrnstein, 1970). This matching phenomenon appears to be quite general and has been demonstrated to occur across a wide range of species, reinforcers, and responses (e.g., Conger & Killeen, 1974; Matthews & Temple, 1979; Neef, Mace, &

Shade, 1993). Further, a change in the rate, magnitude, or quality of reinforcement for one operant in a concurrent operants paradigm generally affects response rates for both schedules.

When assessing relative reinforcer effectiveness with a concurrent operants paradigm, the use of simple free-operant responses (e.g., key pecking, switch pressing, in-square or in-seat behavior) as dependent variables may have advantages over more complex (and perhaps more socially meaningful) responses. First, as previously mentioned, the focus is on teaching the client the contingencies in effect rather than the specific responses. Second, the matching phenomenon, which allows one to determine relative reinforcer effectiveness based on relative response rates, occurs only after an initial acquisition phase (i.e., after the individual has learned the contingencies in effect; Mazur, 1994). This acquisition phase should be shorter, and hence matching should occur faster, for a simple free-operant response than for a more complex response. In addition, given the generality of the matching phenomenon, the relative response rates associated with two schedules, amounts, or types of reinforcement in a concurrent operants paradigm should hold across dependent variables, as long as the stimuli used as consequences are functional reinforcers for the responses used as dependent variables.

This is not to suggest that a stimulus identified as more preferred using a concurrent operants paradigm with a simple free-operant response (in-seat behavior) will necessarily function as a reinforcer for more complex and clinically relevant responses (e.g., acquisition of language or hygiene skills) or that stimuli identified as less preferred will not function as reinforcers when assessed in a single-operant paradigm. A given stimulus may function as a reinforcer for one response but not for another. In addi-

tion, the same stimulus may function as a reinforcer for a given response in one situation but not in another, and may not function as a reinforcer for the same response in the same situation at a different point in time. However, given the generality of the matching phenomenon, we hypothesize that in a concurrent operants paradigm, the stimulus identified as the more effective reinforcer for one behavior (e.g., sitting in a chair) is likely to function as the more effective reinforcer for another behavior (e.g., manding). Future investigators may wish to determine the extent to which relative reinforcer effectiveness observed using a concurrent operants paradigm with one response or dependent measure generalizes to other responses.

In the current investigation, a concurrent operants paradigm was used to evaluate the relative quality of reinforcers (e.g., high vs. middle). That is, potential reinforcers were concurrently available, and the reinforcer efficacy of a stimulus was evaluated relative to the efficacy of the other available stimuli. Because the methodology involves providing concurrent alternatives, it is well suited to evaluation of specific parameters of reinforcer substitutability—the extent to which the strength of a response is maintained when one reinforcer is replaced by a qualitatively different one (L. Green & Freed, 1993). Substitutability is dependent upon context (Rachlin, Kagel, & Battalio, 1980), in that one reinforcer may easily replace another in some situations but not in others. One important contextual variable that affects substitutability is the availability of other reinforcers (e.g., a generic cola may substitute for Coke® when water is the only alternative drink but not when Pepsi® is a concurrently available reinforcer). Using an adaptation of the current methodology, the substitutability of two reinforcers could be assessed in conditions in which a high-, middle-, or low-preference stimulus was concurrently avail-

able. Reinforcers found to be highly substitutable (i.e., in all conditions) could then be used across clinical settings.

REFERENCES

- Catania, A. C. (1963). Concurrent performances: A baseline for the study of reinforcement magnitude. *Journal of the Experimental Analysis of Behavior*, 6, 299–300.
- Cautela, J. R., & Kastenbaum, R. A. (1967). A reinforcement survey for use in therapy, training, and research. *Psychological Reports*, 20, 1115–1130.
- Conger, R., & Killeen, P. (1974). Use of concurrent operants in small group research. *Pacific Sociological Review*, 17, 399–416.
- Dattilo, J. (1986). Computerized assessment of preference for severely handicapped individuals. *Journal of Applied Behavior Analysis*, 19, 445–448.
- Fehr, M. J., Wacker, D., Trezise, J., Lennon, R., & Meyerson, L. (1979). Visual, auditory, and vibratory stimulation as reinforcers for profoundly retarded children. *Rehabilitation Psychology*, 26, 201–209.
- Fisher, W. W., Piazza, C. C., Bowman, L. G., & Amari, A. (in press). Integrating caregiver report with a systematic choice assessment to enhance reinforcer identification. *American Journal on Mental Retardation*.
- Fisher, W., Piazza, C. C., Bowman, L. G., Hagopian, L. P., Owens, J. C., & Slevin, I. (1992). A comparison of two approaches for identifying reinforcers for persons with severe to profound disabilities. *Journal of Applied Behavior Analysis*, 25, 491–498.
- Green, C. W., Reid, D. H., White, L. K., Halford, R. C., Brittain, D. P., & Gardner, S. M. (1988). Identifying reinforcers for persons with profound handicaps: Staff opinion versus systematic assessment of preferences. *Journal of Applied Behavior Analysis*, 21, 31–43.
- Green, L., & Freed, D. E. (1993). The substitutability of reinforcers. *Journal of the Experimental Analysis of Behavior*, 60, 141–158.
- Herrnstein, R. J. (1970). On the law of effect. *Journal of the Experimental Analysis of Behavior*, 13, 243–266.
- Homme, L. E., Csanyi, A. P., Gonzales, M. A., & Rechs, J. R. (1969). *How to use contingency contracting in the classroom*. Champaign, IL: Research Press.
- Matthews, L. R., & Temple, W. (1979). Concurrent-schedule assessment of food preferences in cows. *Journal of the Experimental Analysis of Behavior*, 32, 245–254.
- Mazur, J. E. (1994). *Learning and behavior*. Englewood Cliffs, NJ: Prentice Hall.

- Neef, N. A., Mace, F. C., & Shade, D. (1993). Impulsivity in students with serious emotional disturbance: The interactive effects of reinforcer rate, delay, and quality. *Journal of Applied Behavior Analysis*, 26, 37-52.
- Pace, G. M., Ivancic, M. T., Edwards, G. L., Iwata, B. A., & Page, T. J. (1985). Assessment of stimulus preference and reinforcer value with profoundly retarded individuals. *Journal of Applied Behavior Analysis*, 18, 249-255.
- Rachlin, H., Kagel, J. H., & Battalio, R. C. (1980). Substitutability in time allocation. *Psychological Review*, 87, 355-374.
- Rincover, A., Newsom, C. D., Lovaas, O. I., & Koe-
gel, R. L. (1977). Some motivational properties of sensory stimulation in psychotic children. *Journal of Applied Behavior Analysis*, 24, 312-323.
- Wacker, D. P., Berg, W. K., Wiggins, B., Muldoon, M., & Cavanaugh, J. (1985). Evaluation of reinforcer preferences for profoundly handicapped students. *Journal of Applied Behavior Analysis*, 18, 173-178.

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